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CALENDAR OF EVENTS
Scientific meetings
Page 53

DECEMBER 12, 1988
CHEMICAL & ENGINEERING

NEWS

WORLD CHEMICAL OUTLOOK

Page 26

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NEWS
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News of the Week

■ **Dow Chemical and Pfizer plan to exchange shares of their stock for new financial products called unbundled stock units in effort to boost their earnings per share.** **Page 4**

■ **International group of scientists, environmental leaders, and policy makers calls for developing strategies now to deal with the coming effects of greenhouse warming.** **Page 5**

■ **Science and technology centers to be established by NSF at 11 universities will tackle complex problems.** **Page 6**

■ **New director general of UNESCO is striving to restructure and reinvigorate the troubled United Nations organization.** **Page 6**

Business

Facing a revenue shortfall, Cytogen increases its marketing and licensing operations to obtain funds for expensive clinical trials of its biotechnology-based products. **Page 13**

Virtually odor-free hydrocarbon solvents for the paints and coatings industry are introduced by Shell Chemical. **Page 14**

Government

"Blueprint" presented to President-elect Bush by environmental coalition lists over 700 recommendations for management of environmental problems. **Page 19**

Japan has pulled even with U.S. in scientific and technological resources, NSF report shows. **Page 20**

Technology

Chromatography columns that mimic cell membranes show promise in separating and purifying proteins and other biochemical entities. **Page 23**

Low-cost cleanup of toxic petrochemicals from soil and groundwater is offered by innovative "steam-cleaning" process. **Page 24**

Books

Drama behind discovery of the endorphin enkephalin makes interesting reading for half of book, but remainder loses focus. **Page 45**

Meetings

C&EN's semiannual calendar of meetings and events lists those of interest to chemists, chemical engineers. **Page 53**

Cover: Imtek Imagineering/Masterfile

Letters 2

Concentrates
Business 7
Government 16
Science/Technology 22

The Departments
ACS Comment 47
ACS News 49
Newscripts 72

With demand for chemicals strong and supplies generally tight, chemical companies throughout the industrialized world expect to chalk up another year of rising sales and profits in 1989 as they continue to run their plants at close to design limits. **Page 26**

Chemical & Engineering News

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LETTERS

CHEMICAL SAFETY

1,1,1-Trichloroethane

SIR: A recent explosion during welding on a tank containing 1,1,1-trichloroethane illustrates the fact that this "safer" solvent is, in fact, flammable and can form explosive mixtures with air, though it has no recorded flash point. Wrightson and Santon [*IChE Loss. Prev. Bull.*, **83**, 21 (1988)] give a full description of the incident in a 1050 cubic meter tank holding 70 metric tons of inhibited solvent under nitrogen to exclude moisture. Owing to gas leaks in the roof, the nitrogen supply system had been switched to manual operation, and insufficient gas had been fed into the tank after a previous removal of 1150 metric tons to displace the air drawn in. When arc welding repairs were started, the resulting explosion separated the tank roof from the walls for two thirds of the 36-meter circumference. Another explosion had been recorded when the end of an "empty" 200-L drum was being cut with an oxy-acetylene torch. Limits of flammability for 1,1,1-trichloroethane are narrow at 8.0 to 10.5% at 25 °C, with an autoignition temperature of 500 °C.

There seems to be an unfortunate tendency in many safety reference sources to describe partially chlorinated hydrocarbons for which no flash points are determinable by standard tests (because they are difficult to ignite), as nonflammable. Other examples of solvents of this type are dichloromethane (calculated flash point −9 °C, limits 12 to 19%, autoignition temperature 605 °C) and trichloroethylene (flash point 32 °C, wide limits 12.5 to 90%, autoignition temperature 410 °C). All three will ignite if the vapor temperature and ignition energy or temperature are sufficient. The same is true for bromomethane (limits 13.5 to 14.5%), formerly used to extinguish fires.

L. Bretherick
Bridport, Dorset, U.K.

Refocusing general chemistry

SIR: I was interested in Ward Worthy's report on the symposium on refocusing general chemistry held at the ACS meeting in Los Angeles (C&EN, Oct. 17, page 25). I did participate in this symposium and found it a useful forum in which to express and formulate my ideas on general chemistry and also to learn those of others. In addition to the points mentioned in Worthy's report, I found special interest expressed there in persistent errors propagated in current introductory texts such as the fiction that dissolved ammonia occurs in dilute aqueous solutions as ammonia molecules, the uncritical use of valence shell electron pair (VSEPR) theory in spite of its well-known conceptual inadequacies, and the common misrepresentation through oversimplification of equilibria in aqueous solutions, a particularly egregious example of which was given by Stephen Hawkes in his formal talk. I think all concerned would like to see such error eliminated or at least minimized. Yet the current record suggests that that desire is not likely to be satisfied so long as new texts depend heavily on those of the previous generation for much of their standard material. It would seem that a special effort is required to eliminate or minimize this way of perpetuating error in introductory textbooks.

An important point of general interest concerning the role of high school chemistry arose during the open forum that wrapped up the symposium. It was pointed out that the need for incorporating more descriptive chemistry into the college-level introductory chemistry course could be attributed, in part at least, to the paucity of such material in the high school courses. It was felt that the driving force for many high school instructors was to give their students a leg up in competing on the college level. As a result, the high school courses tend to emulate the introductory college courses. In this light, it was wondered whether any changes in the introductory college course would not soon be undermined by similar changes in the high school courses?

Hawkes deserves special commendation for his successful organization of this stimulating symposium.

Thomas R. Tuttle Jr.
Professor of Chemistry
Brandeis University

Nuclear power

SIR: The Government Concentrates page (C&EN, Oct. 24, page 15) carried an item entitled "Voters to decide on environmental issues." The item listed several environmental issues, but also included a comment about a Massachusetts referendum in which "voters will be asked to stop the commercial generation of nuclear power as of July 4, 1989."

Come on, C&EN! You should know—as all the rest of us know—that the antinuclear activists are not environmentalists. A sincere and realistic environmentalist supports nuclear power because it is cleaner and more environmentally ac-

"Blueprint" Details Environmental Challenges Faced by New President

Document comprises over 700 recommendations on global warming, ozone depletion, waste disposal, public-land stewardship, other issues

In an unprecedented effort called "Blueprint for the Environment," 30 major U.S. environmental groups have banded together to offer the incoming Bush Administration more than 700 recommendations on how to manage near-crisis proportion environmental problems affecting the U.S. and the world.

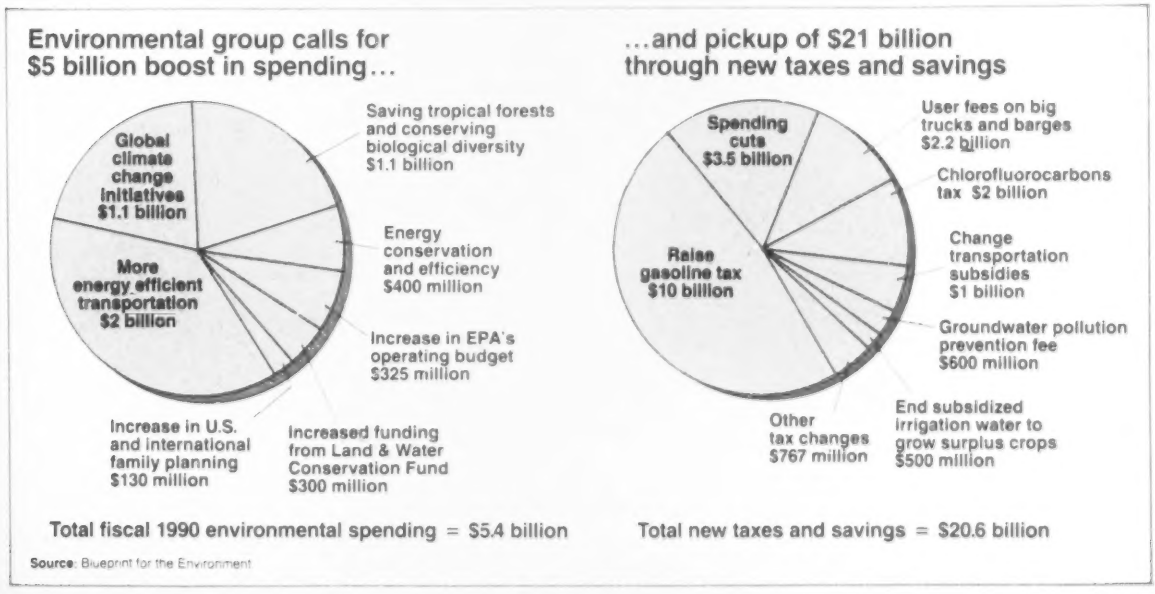
According to Thomas B. Stoel Jr., a senior attorney at the Natural Resources Defense Council, President-elect George Bush "faces environmental problems that rank with nuclear war" in their ability to wreak havoc. High on the list of potential environmental disasters is alteration of Earth's climate, the so-called greenhouse effect.

"The crisis is so pressing and so forbidding," says Jay D. Hair, president of the National Wildlife Federation, "that the problems transcend political parties, indeed, even nations." But the saving grace, he says, is that the solutions to the problems are within grasp: "No new leaps in technological progress are needed." In addition, the coalition believes that many of the problems facing the U.S. can be dealt with through executive order. Few require Congressional action.

In a meeting with the President-elect, leaders of six U.S. environmental groups, all part of the coalition, presented their tome of recommendations in "Blueprint for the Environment" and urged Bush to exert control quickly and emphatically. Hair says the coalition initially will judge Bush's leadership by "the quality of key appointments" he makes to head the Energy and Interior departments and the Environmental Protection Agency.

The environmental leaders also say it is essential that Bush provide world leadership, especially when dealing with the issues of global warming and stratospheric ozone depletion. John H. Adams, executive director of NRDC, cites "global warming as the single most serious problem facing the world." He contends that President Bush's "reign will be judged on the success or failure of work on global warming."

As a group, the leaders believe that on domestic issues Bush has to come to grips with the issue of toxic substances. In that regard, the blueprint effort urges that the newly elected President call for swift renewal of the Clean Air Act and get a handle on the disposal of toxic waste and the cleanup of abandoned hazardous waste sites.


Environmental group calls for $5 billion boost in spending...
Global climate change initiatives $1.1 billion
Saving tropical forests and conserving biological diversity $1.1 billion
Energy conservation and efficiency $400 million
More energy efficient transportation $2 billion
Increase in EPA's operating budget $325 million
Increase in U.S. and international family planning $130 million
Increased funding from Land & Water Conservation Fund $300 million
Total fiscal 1990 environmental spending = $5.4 billion
...and pickup of $21 billion through new taxes and savings
Spending cuts $3.5 billion
User fees on big trucks and barges $2.2 billion
Chlorofluorocarbons tax $2 billion
Change transportation subsidies $1 billion
Raise gasoline tax $10 billion
Groundwater pollution prevention fee $600 million
Other tax changes $767 million
End subsidized irrigation water to grow surplus crops $500 million
Total new taxes and savings = $20.6 billion
Source: Blueprint for the Environment

To curb pollution, "we must deal with the root cause: the generation of waste," says Hair. The blueprint recommends that Bush make waste reduction and recycling of waste a national priority. To do this, economic incentives and technical aid should be given to states and local governments.

And the environmental groups ask Bush to embrace the ethic of public-land stewardship, something, they feel, the Reagan Administration lacked. Public lands must be managed on a sound ecological basis; that is a given. But the environmental coalition also asks Bush to direct his Interior and Agriculture secretaries to ensure that lease or sale of resources belonging to the public be done "at full and fair market value," says the president of the National Audubon Society, Peter A. A. Berle.

According to Berle, "The key to a lot of what happens to the domestic environment is based on sound energy policy." Among the blueprint recommendations is improved energy efficiency, particularly the achievement of 45 miles per gal for the U.S. auto fleet by the year 2000. Another is to stress the development of renewable energy technologies, especially solar photovoltaic systems.

The blueprint coalition believes that Bush could demonstrate his support for enhanced environmental protection in two ways. First, elevate EPA to a Cabinet-level department. And second, increase EPA's operating fiscal 1990 budget 20%.

The shadows cast by the burgeoning deficit are long. And members of Bush's transition team say that expecting an increase in the agency's budget is wishful thinking. However, a Capitol Hill source familiar with environmental matters says that "Bush's folks are seriously considering" raising EPA to Cabinet level. As this source sees it, "That move would establish him as an environmentalist and would not hurt industry that much."

The blueprint effort counters the deficit argument with some budget proposals of its own. It says that $5.4 billion is needed for essential new environmental thrusts, including an additional $325 million for EPA and $1.1 billion for global climate change initiatives. But, it claims that through judicious spending cuts and increases in some taxes, $20.6 billion can be raised in fiscal 1990. According to this scheme, essential environmental programs can be funded and the federal deficit can be reduced by $15.2 billion.

Most of the increased revenue would come from taxes on ozone-depleting substances, gasoline tax increases, and users fees on large trucks and barges. The blueprint effort suggests an increase of 10 cents per gal in the gasoline tax. The Capitol Hill source says, "That's a bad idea. If you really want it to work you have to slap on a 50-cent or dollar per gal tax."

Basically the blueprint effort highlights environmental goals and recommends traditional means of achieving them. It calls for the rapid renewal of the Clean Air Act, including legislation to control acid rain. And it recommends tax increases, such as the one for gasoline, as means for promoting energy efficiency and paying for new environmental thrusts.

Not all major environmental groups are in harmony with these traditional approaches. "The problems are getting bigger, the solutions need to get better," Environmental Defense Fund executive director Frederic D. Krupp explains. His group was more comfortable working with Sen. Timothy E. Wirth (D.-Colo.) and Sen. John Heinz (R.-Pa.) on "Project 88." This effort resulted in 36 recommendations that "emphasize market-based incentives and solution-oriented approaches," Krupp says. "We're certain that the way to make progress [in stemming pollution] is to use the free market to steer the economy in the right direction," he adds.

The upshot is that Bush will be faced with another set of environmental recommendations to ponder. He was receptive to the environmental leaders who presented him with "Blueprint for the Environment." He smiled when Hair said, "Read my lips. Protect the environment." He answered, "I will." But he never told them in concrete terms how he would.

Lois Ember

Japan even with U.S. in high-tech indicators

Japan-watching is the craze in U.S. industry and government today. In almost every high-tech indicator except chemical processing and aeronautical engineering, Japan has pulled even with or drawn ahead of the U.S. A study of the scientific and technological resources of Japan and the U.S. just issued by the National Science Foundation tells why.

The report does not assess the Japanese "threat." However, a reader can draw a few conclusions from its 69 pages of text, charts, and tables. Data cover such areas as industrial productivity, patent activity, research and development in industry, patterns of science education, trade in high-tech areas, trends in R&D expenditures, and a lot more.

In the report, prepared by NSF science resources analyst Maria Papadakis, a number of items seem to stand out:

- Japan's science and technology resources (commitment to spending and education, growth in proportion to gross national product) are now on a par with the U.S.
- The relationship of R&D to GNP is about the same for both countries: 2.7 to 2.8%.
- Industrial research accounts for 69% of all research in Japan and the percentage seems to be growing. The U.S. ratio of government/industry research funding is about 50-50.
- Industrial R&D is 98% self-funded in Japan, 65% in the U.S. (with U.S. government providing the other 35%).
- Defense accounts for only 1% of Japan's R&D budget. In the U.S. it's 30%.
- Japan has about a third of the number of scientists as the U.S. does, but has slightly more engineers per 10,000 of the labor force than has the U.S.—187 to 183.
- Japan's share of world scientific literature is 7%, versus 39% for the U.S. But Japan's share of patents granted in the U.S. grew from 4% in 1970 to 19% in 1986.
- Between 1965 and 1985, the U.S. share of world exports in high-tech goods fell from 28% to 24%, while Japan's share rose from 7% to 19%.

Priorities list of Japan's research leaders

- Preventive measures for cancer metastasis.
- Elucidation of the biological cause and development of cancer cells.
- Development of technologies for major earthquake forecasting.
- Measures for controlling the growth of cancer cells.
- Clarification of growth mechanism of cancer cells.
- Storage and disposal of high-level radioactive solid wastes.
- Automatic protocol conversions to facilitate information flows between communications networks.
- Establishment of global integrated services digital network with automatic domestic access.
- Application of computer-aided design technology to design logic large-scale integration semiconductors of 1 million gates or more.
- Advanced software verification technology for rapid development of error-free, large software systems.
- Introduction of fast breeder reactors and establishment of complete nuclear fuel cycle facilities.
- Widespread use of antivirus agents for treatment of viral diseases.
- Industrial application of superconducting materials with T_c (transition temperature) higher than 77 K.
- Methodologies for analysis of protein structures so as to predict their functions.
- Technologies for designing primary protein structures to fulfill specific functions.

Source: Delphi Survey conducted by Japan Science & Technology Agency

Japan's world export share rose as U.S.'s slipped

% share of world export market	Japan		U.S.	
	1975	1985	1975	1985
Aircraft and parts	0.3%	0.4%	61.9%	50.9%
Industrial inorganic chemicals	6.4	4.2	18.4	20.7
Radio and TV receiving equipment	46.3	78.2	6.5	0.6
Office and computing machines	9.2	17.7	31.3	33.1
Electrical machinery and equipment	8.7	18.4	21.2	21.9
Communications equipment	14.9	37.0	24.4	16.1
Professional and scientific instruments	15.3	30.0	19.6	16.9
Drugs	2.0	2.7	13.6	18.4
Plastic materials, synthetics	12.0	9.6	12.0	13.2
Engines and turbines	8.7	17.7	25.9	29.4
Agricultural chemicals	12.0	3.2	24.1	30.7
All products	11.6	19.4	24.5	24.2

Source: National Science Foundation

• Japan is becoming an exporter of technical know-how. Its percentage of receipts-to-payments for technology licenses increased from 14% in 1970 to 30% in 1985. But it still is paying record licensing royalties of $1.3 billion (1985) for foreign technology.

• Japan's productivity increased 68% between 1977 and 1986, whereas the U.S. increase was 26% during the same period.

According to the report, Japan has taken three important turns in its science and technology policy during the past four years. It has shifted its research focus toward fundamental research, reformed some of the more "constraining" aspects of its R&D system, and decided to participate more fully in the international scientific community. All this was beginning to happen before negotiations began for the science and technology exchange agreement between the U.S. and Japan that was completed last June.

The shift in focus sprang from the technical community's realization that future growth and the fulfillment of national goals would have to derive from more indigenous scientific research. The U.S. could no longer provide the model, the Japanese concluded. Biotechnology, the software and hardware of information science, and energy-related research are sectors tabbed for emphasis in government and industrial research. But basic research will be stressed across the board, with universities, government agencies, and corporations all cooperating—or learning how to cooperate—to set priorities.

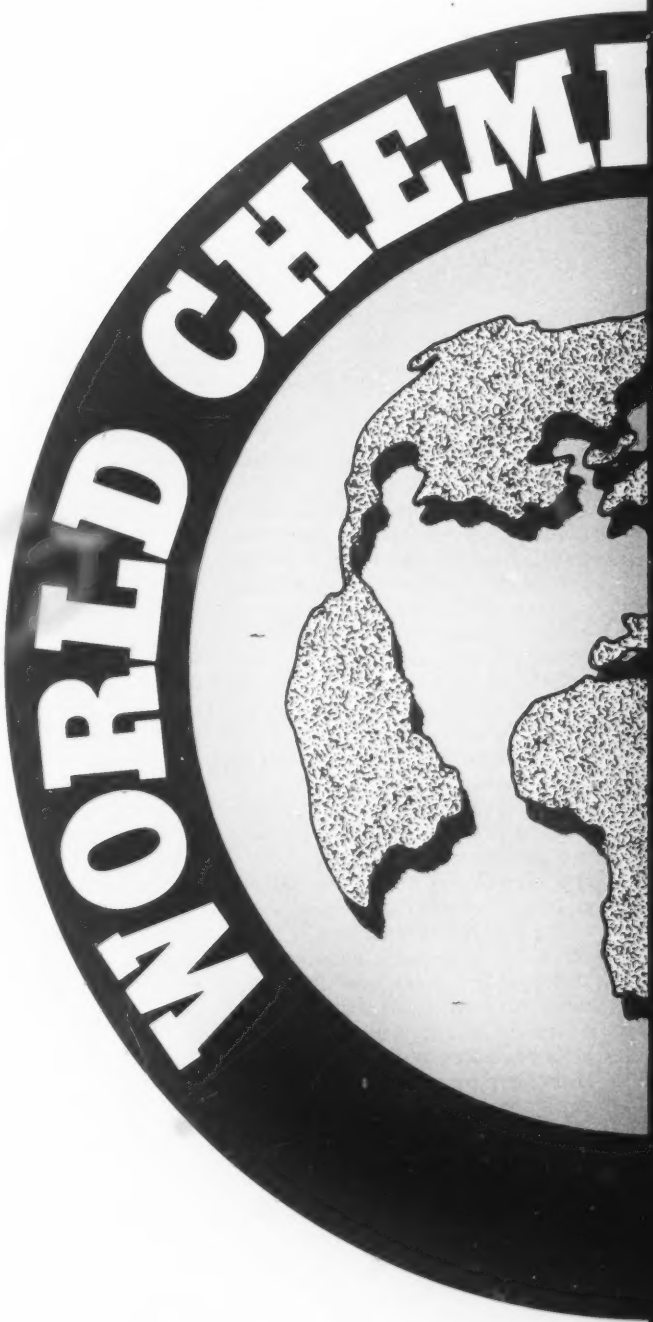
The structural reforms relate to the shifts in focus. The government's role in research is declining, and to effect more efficient spending, the focus is on limiting the life of new research programs to no more than a decade. Additionally, the Japanese Science & Technology Agency has been given a stronger coordinating role. Educational reforms aimed at training young people to think more creatively and independently are being emphasized, as is promoting more vigorous university-industry-government cooperation in research.

In the international sphere, Japan for the past few years has said it wished to reciprocate for all that it had received from Western science and technology. Shortages of spacious housing, the language barrier, and lack of interest by Westerners in doing research in Japan has inhibited any quick progress. But the country is gearing up to address those problems.

One issue that invites reflection by American policy makers is what Papadakis cites as the declining role of the Japanese government in research, from an annual growth rate of 6% during the 1970s to about 3% between 1980 and 1985. As it is, government research accounts for only about 20% of the total in Japan, with industry accounting for the rest.

"Thus," she says, "for the 1980–85 period, it appears that Japanese industry is rising to the challenge of continued increases in Japan's total R&D and basic research. Although the performance of R&D in Japan historically has been compartmentalized, as reforms are made throughout the R&D system, the ability of the Japanese to improve the efficient [use] of their research funds may be increased." She says the compartments are breaking down. There are now collaborative projects among sectors, industrial funding of academic research, and new ways to leverage research funds among sectors.

Wil Lepkowski



Chemical company executives in all the major industrialized nations of the noncommunist world are in happy harmony this year's end as they sing the praises of business conditions in their industry.

The tidings sound similarly glad whether they come from North America, Western Europe, or the Far East—which, perhaps, attests to the increasing interdependence, integration, and globalization of the world's chemical operations.

Business just about everywhere has rarely been brisker. Plants frequently are operating full out to take care of customers' orders. A seller's market provides chemical marketers the untypical privilege of marking up their prices, even as a glut in world crude oil supplies has forced down the cost of petrochemical feedstocks. Chemical organizations, meanwhile, remain trim and efficient following the massive restructuring during the mid-1980s that has drastically revamped the industry. The upshot: The industry's profits have been surging worldwide.

Few people in the industry expect growth in sales and earnings to continue next year at the same pace. In fact, that probably would be physically impossible, considering how tight supplies of basic chemicals are now. And economists, by and large, are convinced that the rate of economic expansion is likely to falter at least a bit during the next 12 months in most of the industrialized world. But the industry is moving into 1989 propelled by strong momentum and seems confident that it can cap the current decade with its seventh year in a row of higher sales and operating profits.

So for the present, fears that the siren song of high demand and heady prosperity will lure the industry again into a reckless round of plant buildup—with the inevitable result of glutted markets and cutthroat competition—are being put aside for the 1990s. Meanwhile, too, there is nothing like a strong cash flow to distract attention from workaday problems like increasing safety and environmental regulation, potential competition from developing countries, or basically maturing markets and product lines.

United States	28
Foreign Trade	31
Western Europe	34
Japan	38
Canada	41
U.S.S.R./ Eastern Europe	43

United States

Chemical business will be brisk despite slower growth

Hard-pressed to fill customers' orders, producers are reaping the rewards of a seller's market

David M. Kiefer, C&EN Washington

As 1988 began, executives of the U.S. chemical industry recognized that 1987 would be a hard act to follow. Business remained excellent, to be sure. Many plants were running close to capacity. Demand was strong, both in domestic and foreign markets. Selling prices were rising. And profits for the year just past had surged. Altogether, 1987 had been a stunning performance.

But there also had been many clouds on the economic horizon. Growth seemed to be faltering in several major markets. Fears were widespread that consumer confidence had been severely shaken by the collapse of stock values on Wall Street the previous October. The overall U.S. economy looked more than a bit unstable.

As it turned out, however, these fears were largely groundless. Economic growth during the past year has continued at a much faster pace than most business analysts had deemed likely 12 months ago.

Now, if the crystal balls of economic seers are to be believed, the U.S. economy will eke out another year of economic growth in 1989. And that is very good news indeed for U.S. chemical producers.

This year has been easily the best of the current six-year business expansion. Domestic demand for chemical products has seemed almost insatiable throughout 1988. Overseas markets have been even more buoyant, thanks to the competitive advantage bestowed by a weak U.S. dollar. Consequently, production of industrial chemicals, plastics, and synthetic fibers now is about 4% higher than it was late last year. For 1988 as a whole, output will be about 6 to 7% higher than in 1987.

That's not quite a match for the increase of almost 10% that the industry chalked up last year, but it's better than in most recent years. And demand for chemicals remains so strong that output would have expanded even higher this year if the industry had more plant capacity available. Earlier in the 1980s, demand was much softer and producers of basic chemicals, plastics, and synthetic fibers seemed confronted with several maturing markets. Much capacity was underutilized. Prices were depressed. And profit margins were unacceptably thin. So the chemical industry trimmed back its plant capacity.

For the past couple of years, however, the chemical industry has been running its remaining plants, especially those making plastics and the raw materials needed to produce them, just about full out. According to the Federal Reserve Board's rather theoretical data on capacity utilization, in the overall chemicals and allied products industry plants were pumping out product at 88% of capacity in this year's third quarter, up from 85% a year earlier and from just 68% at the low point during the 1982 recession. Operating rates have not been so favorable for the industry, in fact, for well over 30 years. The Federal Reserve Board figures, moreover, probably understate the situation.

For the second year, therefore, chemical producers have been reaping the benefits of a seller's market. They have been steadily marking up the prices of their products—as any consumer buying antifreeze this winter can well attest. On the average, industrial chemicals will be priced about 12% higher this year than in 1987, a year when prices, in turn, had been hiked about 4%. The rate by which prices are being raised, moreover, seems to be accelerating. Prices of industrial chemicals now are about 15 to 16% higher than last winter. Prices of plastics at present average about 20% more than a year ago. And the price of that key chemical commodity, ethylene, has much more than doubled during the past year or so.

On the other hand, producers of basic petrochemicals have been enjoying a potent break in the cost of their basic raw materials. In October, the price of crude oil was down 31% from 12 months earlier and the price of natural gas was up a mere 1%.

Higher prices, lower feedstock costs, and high plant operating rates are a heady combination, one that has been working wonders for the chemical industry's earnings statements. For companies in the core of the industry—producers of industrial chemicals and polymers—the opportunity to supply bulging demand at higher prices translates into a hefty increase in dollar sales of between 15 and 20% this year to about $115 billion (exclusive of sales of foreign subsidiaries). Earnings, in turn, are likely to be 50 to 60% higher for the year as a whole, soaring to an all-time high of nearly $11 billion. This year's gains are even better than last year's, when

earnings climbed about 40% on a 12% increase in sales.

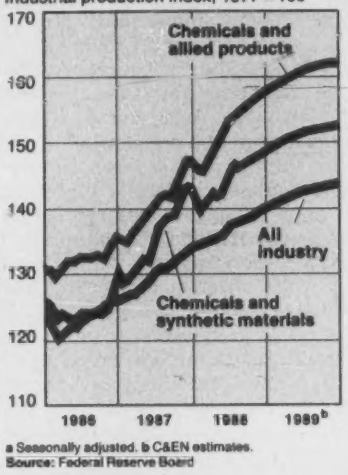
It's not just the core of the industry that is doing well, moreover. Pharmaceutical makers—a key segment of the overall chemicals and allied products industry—likewise have had a banner year. Several drug companies have benefited from the high rate with which they have been introducing new products, ones in many cases that command premium prices and were developed for treating chronic conditions over extended periods. A number of companies, too, like their colleagues in the basic chemicals sector, have restructured their operations in recent years to eliminate operations of marginal profitability and upgrade their manufacturing and marketing efficiency. Consequently, drug companies' sales probably will be up 10 to 12%, as net income climbs 50 to 60%.

Fertilizer companies, too, have enjoyed a turnaround in their business during the past year or so, after several relatively depressed years. With farm income rising, demand has been strong, export markets are even stronger, selling prices are up, ammonia and urea plants are running close to capacity, and profits are rebounding.

It has been a good year, as well, for the diverse assortment of companies that make up the specialty chemicals business, producers whose output ranges from adhesives to water treatment chemicals. Specialty firms that use petrochemical intermediates to formulate their own products have had a problem, however. If they lack a captive source, they have been faced with fast-rising raw materials costs. They, too, have been increasing their selling prices to compensate. But doing so has not always been easy, and, as a result, many specialty producers have been faced with a cost-price squeeze in the past year or so. Even so, sales are strong and profits are improving, if not at the same rate as in the basic chemical arena.

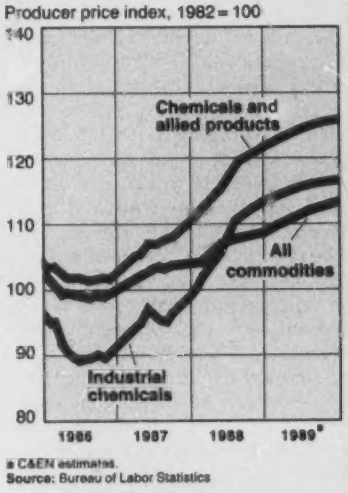
For the overall chemicals and allied products industry, therefore, output will be 8 to 9% higher than in 1987, sales are expected to rise 12 to 15%, and profits are likely to be up 40 to 50%.

With chemical production continuing to expand . . .



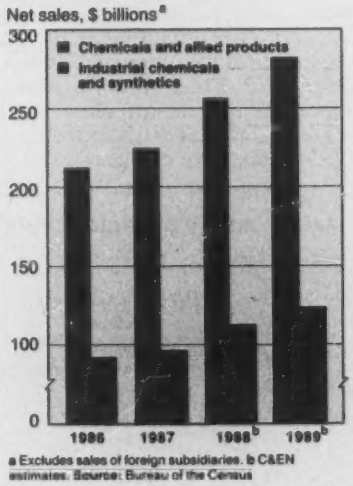
a Seasonally adjusted. b C&EN estimates.
Source: Federal Reserve Board

. . . and prices likely to be higher . . .



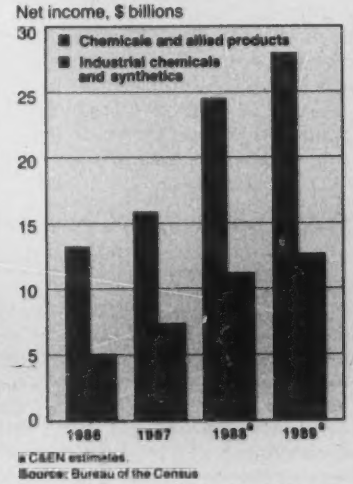
a C&EN estimates.
Source: Bureau of Labor Statistics

. . . sales will be strong again next year . . .



a Excludes sales of foreign subsidiaries. b C&EN estimates. Source: Bureau of the Census

. . . and chemical firms' profits will rise further



a C&EN estimates.
Source: Bureau of the Census

All in all, then, the chemical industry enters the new year riding on strong momentum. Industry executives are optimistic that a biblical seventh year of plenty lies ahead.

The current consensus of economic opinion pegs growth of the U.S. economy at about 2% for 1989, give or take a half percentage point or so. That's on the heels of a 4% increase in constant-dollar gross national product expected this year.

Economists generally welcome such a slowdown, moreover. With an unprecedented six years of expansion behind it, the nation's economy is running nearly as full out as is feasible without developing serious stresses. Continued rapid growth, economists fear, would only result in uncontrollable inflation and dangerously higher interest costs.

The chemical industry, too, probably would be hard put to expand its output for another year at the same rate as in the past two years. Even if the industry shows no further growth above current levels of production, its output during 1989 will be about 3% higher, on aver-

age, than this year. It probably will do better than that, though. If the U.S. economy pulls off a 2% growth rate during the year ahead, total production of industrial chemicals and synthetics is likely to climb 4 to 5%. Prices will continue to be firm to higher again, moreover, probably averaging 6 to 8% over this year's level. Sales, as a result, are likely to rise 10 to 12% and earnings will do at least as well.

Several key markets for chemicals bear watching, however. Housing is one. New housing starts have been falling from 1986's peak level of 1.8 million. Last year, housing starts totaled 1.62 million; this year they probably will reach no more than 1.4 million to 1.5 million. And next year, in the face of rising costs and higher mortgage interest rates, chances are that they will drop slightly further. That, in turn, will pinch demand for a variety of plastics, coatings, and fibers.

A slight decline in U.S. automobile production in 1989 also will not be surprising. Sales of cars and trucks in the U.S. probably will total about 15.6 million to 15.8 million units this year. Domestic production of new cars, meanwhile, will be about 7.1 million, practically unchanged from the year before.

Auto industry officials are generally sanguine about 1989. In fact, they recently announced plans to roll 14% more cars off their assembly lines in the first quarter of the new year than they made in the like period of 1988. But they may not maintain that pace for the whole year. Current forecasts from Detroit, in fact, foresee at least a slight dip in sales volume, to somewhere in the neighborhood of 10 million cars and 5 million trucks.

On the other hand, demand for fertilizer and other agricultural chemicals is expected to be good. Farm income is high at present and U.S. farmers are likely to sharply increase the acreage they have under cultivation to make up for crops lost in this year's drought and to take advantage of higher farm prices.

All told, moreover, consumer confidence remains high, according to recent surveys, and consumer income is rising as the ranks of employed workers continue to grow apace. That bodes well for many important outlets for chemicals. Slight gains are expected, for example, in demand for appliances, clothing and other textile products, and furniture. And with the dollar remaining weak against major foreign currencies, U.S.-made chemicals will retain their competitive advantage in foreign markets.

Thus, for the third straight year, chemical producers are likely to be more concerned with filling orders than drumming up new business. Therein lies one big concern of many industry observers. With demand pressing tightly against plant capacity, pressures are building to expand chemical facilities. So far, expansion has been largely limited to incremental additions at existing plants through process improvements and debottlenecking. These have allowed producers to satisfy customers' needs without heavy investments in new plants.

But already, construction is under way or plans have been announced for a few new petrochemical plants. That raises the specter, at least in the minds of some industry observers, of another glut of excess capacity and crumbling profits sometime in the 1990s if a business recession should crimp markets just as a bevy of new plants come on stream. □

Output will be up this year and next for nearly all major chemicals and polymers

	1986	1987	1988	1989
INORGANIC CHEMICALS				
Thousands of tons unless otherwise indicated				
Ammonia	14,487	16,095	16,900	17,750
Chlorine gas	10,442	11,019	11,400	11,600
Hydrochloric acid	2,392	2,869	2,900	3,000
Nitric acid	6,736	7,225	7,900	8,300
Oxygen, billions of cu ft	347	390	460	475
Phosphoric acid	9,578	10,685	11,700	12,300
Sodium hydroxide	10,405	11,486	11,900	12,100
Sulfuric acid	35,993	39,235	42,300	44,000
ORGANIC CHEMICALS				
Millions of lb unless otherwise indicated				
Acetic acid	2,728	3,246	3,300	3,350
Acetone	1,910	1,846	1,975	2,000
Acrylonitrile	2,182	2,452	2,550	2,650
Benzene,[a] millions of gal	1,362	1,576	1,640	1,680
Butadiene	2,546	2,931	3,100	3,175
Caprolactam	1,109	1,156	1,250	1,300
Cumene	3,745	4,105	4,500	4,700
Cyclohexane	2,070	2,276	2,300	2,350
Ethylene	32,859	34,951	36,500	38,500
Ethylene glycol	4,771	5,183	5,300	5,350
Formaldehyde	5,549	5,733	6,200	6,300
Methanol	7,205	7,537	6,800	7,300
Phenol	3,115	3,351	3,550	3,750
Phthalic anhydride	863	1,035	1,150	1,200
Propylene	16,522	19,019	19,600	20,500
Styrene	7,888	8,014	8,600	8,900
o-Xylene	788	939	950	1,000
p-Xylene	5,035	5,155	5,550	5,750
PLASTICS				
Millions of lb				
Polyethylene, high density	7,182	7,999	8,400	8,750
Polyethylene, low density	8,903	9,629	10,300	10,800
Polypropylene	5,812	6,647	7,400	7,900
Polystyrene	4,470	4,782	5,150	5,400
Polyvinyl chloride	7,256	7,971	8,450	8,800
SYNTHETIC FIBERS				
Millions of lb				
Acrylic and modacrylic	616	592	600	605
Nylon	2,515	2,690	2,725	2,775
Olefin and vinyon	1,393	1,494	1,620	1,725
Polyester	3,305	3,540	3,650	3,700

a Petroleum refiners only. **Sources:** Bureau of the Census, International Trade Commission, Society of the Plastics Industry's Committee on Resin Statistics, Textile Economics Bureau, C&EN estimates (for 1988 and 1989)

Surplus in U.S. chemical trade widens to new record

Weak dollar and strong overseas demand bring surge in exports, but U.S. chemical imports rise surprisingly also

Earl V. Anderson
C&EN Northeast News Bureau

It took eight years, but by the time this year's trade statistics are tallied, the U.S. chemical industry undoubtedly will have eclipsed the old record for its trade surplus of $12.1 billion that was set back in 1980.

Riding on a weaker U.S. dollar and strong overseas demand, chemical exports from the U.S. will increase about 23% this year to $32.5 billion. That's a level that they haven't even come close to before.

Meanwhile, chemical imports will probably weigh in at a record $20.1 billion, 24% higher than in 1987. Despite this surprisingly high increase, the U.S. chemical industry is likely to end the year with a trade surplus of about $12.4 billion.

This year's strong chemical import performance is surprising because conventional wisdom says that, when the U.S. dollar is weak versus major foreign currencies, U.S. exports become less expensive in the world marketplace and hence, more competitive against products made in other countries. Conversely, foreign products become more expensive in the U.S., so it is more difficult for them to compete against chemicals made at home.

There is no doubt that the U.S. dollar is significantly weaker against other currencies than it was, say, in 1985, when a U.S. dollar was worth an average 251 Japanese yen or 3.15 West German deutsche marks.

But the dollar's depreciation from its levels at the end of 1987 hasn't been nearly so significant as it has been in the past few years. In fact, the dollar staged a mini rally early in the year, recovering some lost ground before resuming its descent in the fourth quarter.

For instance, at the end of 1987, the dollar was worth 128 Japanese yen. By the end of last month, it had fallen, but only to 122 yen. Against the West German deutsche mark, it actually got stronger—1.735 deutsche marks at the end of November compared with 1.642 marks at the end of 1987. Still, at those dollar exchange rate levels, exports normally would be expected to increase faster than imports.

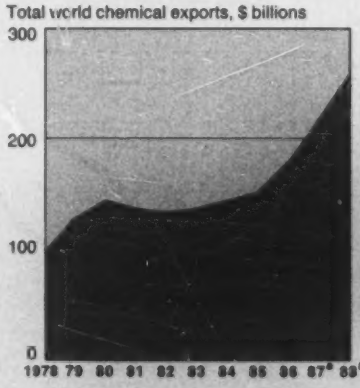
Overall, however, U.S. foreign trade is, in fact, complying with conventional wisdom. Total exports this year will reach almost $253 billion, up 27% over last year, whereas imports will advance only 8% to $440 billion (on a customs basis). This will shave about $33 billion off the well-publicized U.S. trade deficit, bringing it down to $120 billion.

Why isn't the same trend apparent in U.S. chemical trade? Despite the weaker dollar, the prices of chemical imports have been rising more slowly than those for chemical exports. Imports of chemicals, moreover, have been rising faster than exports on a volume basis as well.

Several explanations are possible. Some chemical trade observers say that U.S. companies are intentionally keeping export prices high to squeeze as much profit as they can out of their overseas shipments. Foreign companies shipping chemicals to the U.S., on the other hand, are

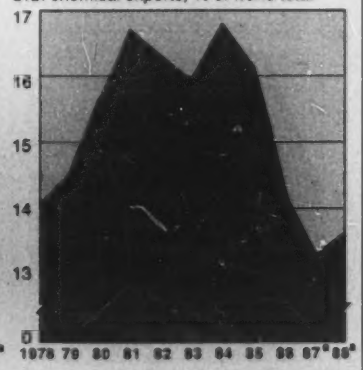
World trade in chemicals continues to surge . . .

Total world chemical exports, $ billions



. . . as U.S. share of total remains relatively low

U.S. chemical exports, % of world total[b]



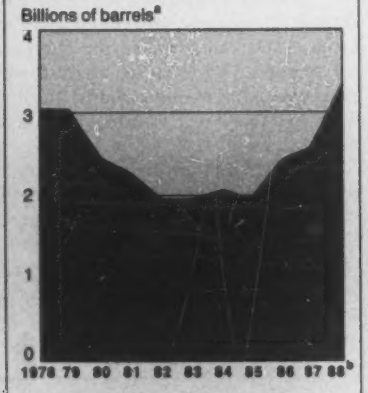
a C&EN estimates. b Defined as U.S. chemical exports as percent of world chemical exports less U.S. chemical imports. **Sources:** United Nations, Organization for Economic Cooperation & Development, European Community, Japanese Ministry of International Trade & Industry

Organic chemicals, plastics, and drugs set pace for strong growth in U.S. chemical exports

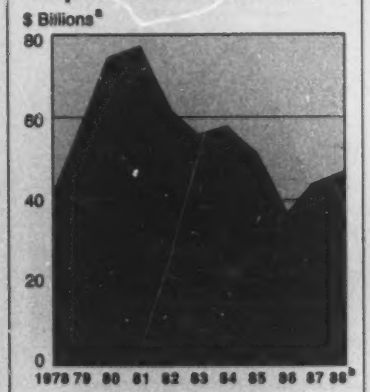
$ Millions	U.S. chemical exports				U.S. chemical imports			
	1988[a]	1987	1986	1985	1988[a]	1987	1986	1985
Organic chemicals	$ 9,296	$ 7,550	$ 6,293	$ 6,012	$ 7,131	$ 5,408	$ 4,704	$ 4,576
Plastics and resins	6,455	5,492	4,301	3,777	2,191	1,987	1,837	1,631
Medicinals and pharmaceuticals	3,884	3,182	3,090	2,708	1,871	1,456	1,240	1,084
Inorganic chemicals	2,555	2,122	1,771	1,967	2,456	2,030	1,894	1,984
Fertilizers, manufactured	2,496	2,259	1,935	2,160	1,035	795	865	967
Pesticides and disinfectants	1,300	732	664	614	697	398	580	399
Radioactive materials	1,043	1,017	1,302	1,311	1,079	1,012	1,382	1,417
Flavors, perfumes, cosmetics, and toiletries	787	579	488	478	907	796	679	577
Pigments, paints, and varnishes	527	411	333	322	476	427	348	266
Cleaning and polishing materials	468	357	302	292	259	205	214	172
Dyeing, tanning, and coloring materials	319	217	174	139	726	621	487	352
Explosives and pyrotechnics	110	91	81	100	183	110	111	103
Miscellaneous	3,260	2,382	2,032	1,878	1,098	968	660	1,005
TOTAL	$32,500	$26,381	$22,766	$21,759	$20,100	$16,213	$15,001	$14,533

a C&EN estimates. Source: Bureau of the Census

Volume of U.S. oil imports climbs sharply . . .



. . . but lower price tags keep the total cost down



a All petroleum products. b C&EN estimates. Source: Bureau of the Census

holding prices down to maintain or increase market share.

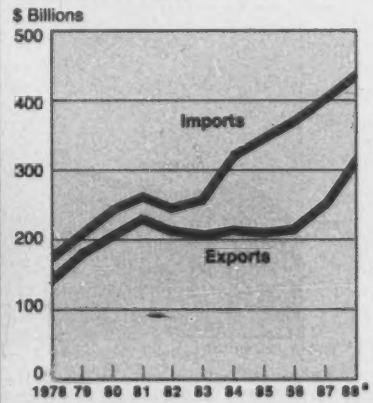
Another possible reason is the difference between what is exported and what is imported. U.S. chemical companies export a lot of commodity chemicals, particularly ethylene derivatives, whose prices have increased rapidly because supplies are tight. Chemical imports tend to be intermediates, whose prices have not risen as much.

Chemical trade statistics seem to bear this out. U.S. exports of plastics and resins, which include several large-volume ethylene derivatives, will rise 18% this year to $6.5 billion. Plastics and resins imports, however, will increase only 10% to just over $2 billion.

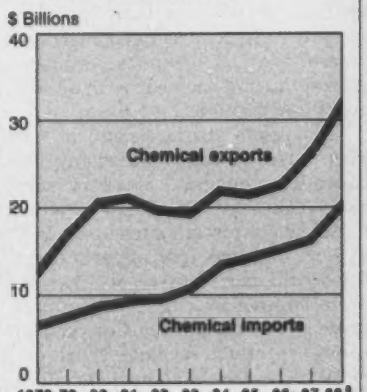
But for organic chemicals, which include most of the intermediates, import growth is far outpacing export growth. Organics imports will hit $7.1 billion in 1988, 32% higher than last year, whereas exports of these products will increase only 23% to $9.3 billion.

In addition, many U.S. chemical plants have been operating at or near capacity this year. These capacity restraints, coupled with shortages of feedstock, also help explain why export volume hasn't grown even more than it has this year. U.S. producers often simply have

Strong rise in exports trims U.S. trade deficit . . .



. . . as surplus in chemical trade widens further



a C&EN estimates. Source: Bureau of the Census

Increased exports of chemicals and other manufactured goods help pare U.S. trade deficit

$ Billion	U.S. exports				U.S. imports			
	1988[a]	1987	1986	1985	1988[a]	1987	1986	1985
Chemicals	$ 32.5	$ 26.4	$ 22.8	$ 21.8	$ 20.1	$ 16.2	$ 15.0	$ 14.5
Machinery and transportation equipment	134.6	109.0	95.3	94.8	193.6	176.7	161.6	137.3
Other manufactured goods	46.6	36.8	30.6	29.3	132.0	119.1	105.5	95.0
Crude materials (inedible) other than fuels	25.4	20.4	17.3	16.9	13.6	11.5	10.4	10.4
Mineral fuels, lubricants, and related materials	8.1	7.6	8.1	10.0	42.9	44.5	37.3	53.9
Food and live animals	25.4	19.3	17.3	19.3	20.7	20.7	20.8	18.6
Beverages and tobacco	4.4	3.5	2.9	3.0	4.0	4.2	3.9	3.7
Animal and vegetable oils and fats	1.5	1.0	1.0	1.4	0.7	0.5	0.5	0.7
All other products	29.4	19.9	11.0	11.0	12.4	12.5	14.9	11.1
TOTAL	$320.0[b]	$252.9[b]	$217.3[b]	$213.1[b]	$440.0	$405.9	$370.0	$345.3

a C&EN estimates. b Includes re-exported imports (not included in individual product categories). Source: Bureau of the Census

not had enough product to satisfy domestic customers and at the same time push export sales.

Meanwhile, because strong economies tend to siphon in more imports, chemical import volume may have increased because of the surprisingly strong U.S. economy in 1988. And the huge foreign investments that recently have been made in the U.S. chemical industry may finally be having a "pull effect" on imports, as foreign companies ship products to their U.S. subsidiaries from their home countries.

Whatever the explanation for the relative strengths of chemical exports and imports, U.S. chemical traders aren't going to waste a lot of time analyzing the situation in a year of record trade surplus. Besides, too many other trade-related matters are commanding their attention.

For instance, they will have to learn to operate under the provisions of the new, huge, and extremely complicated trade bill that President Reagan signed in August. They will have to adjust to a new internationally harmonized system of tariffs that many U.S. trading partners already are using. Under the new trade bill, this harmonized system will replace existing U.S. tariff structures on Jan. 1.

Now that Prime Minister Brian Mulroney and his Progressive Conservatives have been returned to power in Canada, it's likely that Canada will approve the Canadian-U.S. free trade agreement. That means that U.S. chemical companies, like their Canadian counterparts, will have to learn to live with a new set of rules for trade between the two countries.

U.S. chemical companies also will have to learn to live with even more far-reaching new trade rules if 97 countries are able to reach a new trade agreement in the Uruguay round of multilateral trade negotiations. These negotiations, held under the auspices of the General Agreement on Tariffs & Trade (GATT), have been going on since 1986 and probably will last at least until 1990.

But for the past week, the experts who shape trade policy for the U.S. chemical industry have had their eyes focused on Montreal, where GATT negotiators met for a midterm review of progress in the trade talks. For the U.S. chemical industry, the prime concern is that U.S. negotiators don't give away too much in tariff concessions.

Under the new trade bill, the President has the authority, until 1993, to cut existing U.S. tariffs—generally, up to 50%. The chemical industry, however, wants tariff-cutting to be a low-priority exercise in the Uruguay round.

It doesn't want cuts in U.S. chemical tariffs made in exchange for tariff concessions for nonchemical sectors. Nor does it want chemical tariffs cut on an across-the-board, or "formula" basis. Instead, the industry would like to see that whatever tariff cuts are agreed upon are made on the basis of specific requests from foreign countries.

Among other things, the U.S. chemical industry thinks that U.S. emphasis in the multilateral trade negotiations should be placed on improving market access for U.S. exporters, developing codes to cover foreign investment (both in the U.S. and by U.S. companies), intellectual property rights, and safeguards, as well as on improving the existing procedures for settling GATT disputes. At press time, trade officials expected that "framework agreements" on these and other trade issues would come out of the Montreal meeting. □

Deficit widens for U.S. chemical trade with Europe

Millions	1988[a]	1987	% change
U.S. CHEMICAL EXPORTS			
Canada	$ 3,939	$ 3,277	20%
Latin America	4,992	4,407	13
Western Europe	9,425	7,987	18
Eastern Europe	335	344	−3
Japan	4,007	3,422	17
Australasia	1,034	834	24
Communist Asia	1,495	808	85
Middle East	543	423	28
Rest of Asia	5,831	4,121	41
Africa	585	500	17
Other	314	258	22
TOTAL	$32,500	$26,381	23%
U.S. CHEMICAL IMPORTS			
Canada	$ 3,845	$ 3,052	26%
Latin America	1,270	942	35
Western Europe	10,275	8,220	25
Eastern Europe	203	165	23
Japan	2,279	2,150	6
Australasia	376	235	60
Communist Asia	245	200	22
Middle East	308	238	29
Rest of Asia	856	698	23
Africa	115	74	55
Other	328	239	37
TOTAL	$20,100	$16,213	24%

a C&EN estimates. Source: Bureau of Census

Cautious optimism reigns as chemical demand stays high

Some industry analysts fear tight supplies now will spur a capacity buildup, leading to a future market glut

Patricia L. Layman, C&EN London

Buoyant. Glowing health. Renewed vitality. Unbelievable. These are just a few of the words used to describe the chemical industry in Western Europe during the past year.

By any measure, the industry has had a splendid year. A good 1987, in fact, turned out to have been only a dress rehearsal for the year that has followed. With nearly all petrochemical products in tight supply, a situation exacerbated in some cases by fires or other operating problems, selling prices have risen and producers' margins have strengthened to levels that are bringing joy to the hearts of corporate accountants.

Most people in the industry would agree with one company planner who believes that the industry's good fortunes this year are well deserved. "We went through a lot of pain in the early 1980s, with cost-cutting, rationalization, and layoffs. We're reaping the rewards now," he says.

Adds Mario Artali, executive vice president of Milan-based EniChem, with some understatement, "It has been a year in which managing companies has been very easy."

In light of so much positive comment, however, corporate and government crystal balls are hazy at best regarding 1989. Forecasters who saw their cautious optimism last year overwhelmed by surprisingly high growth, now are even more cautious about predicting the coming year. They are using phrases about present business conditions like "not sustainable" and "they can't last forever."

Economic policy, currency movements, political stability, consumer demand all are being factored into next year's forecasts. So, too, are the ramifications of the single internal market planned for the European Community in 1992 and now beginning to take definite shape, as well as the nagging presence of the Middle Eastern petrochemical plants as a potential threat to European marketers.

However, confidence is continuing, despite what probably will be a slight drop in the rate of economic growth during 1989. Growth in output for the chemical industry in Western Europe will average about 5.5% this year. Next year, the rate is expected to drop somewhat, to about 3%, says Alain van de Vaet, chief economist for the European Council of Chemical Manufacturers' Federations.

Says Neville Pinnington, senior division head for bulk petrochemicals at Shell International Chemicals in London: "At the end of last year, people asked, 'Will it continue through the first quarter or the first half?' It was cautious optimism then, because of our firm belief that the peaks and troughs of the economy are inevitable. However, their amplitude seems to be changing."

Why the change? Several companies agree that credit must go to the active economic policies of the Group of Seven—the seven major industrial nations: the U.S., the U.K., West Germany, France, Italy, Canada, and Japan. Montedison executives, for example, think that the successful coordination of policies among this group has resulted not only in relative stabilization of foreign currency exchange rates but also in continued economic growth.

Other companies point out that after the collapse on Wall Street in October 1987, the speed with which financial ministers got together boosted confidence and helped stabilize markets. Governments are looking at things on a global scale, the belief goes, and that is good for industry.

But some companies tend to be a bit more cautious now in their outlook, nevertheless. Although the prospect for next year certainly is better now than it had been earlier in the year, ICI economists say, they see a slowing in business growth in 1989 to as little as half of what it was in 1988, first in the U.S. but spreading later into Europe. However, they don't see any such slowdown influencing profitability in the chemical industry, at least before the seasonally weak third quarter of 1989.

This year, adds ICI, the seasonal summer slowdown was far less pronounced than usual, so that third-quarter profits were way above the levels of the year before. Indeed, according to Hans Albers, chairman of West Germany's BASF, "There was an almost total absence of any seasonal decline (in sales) during the summer months."

"For 1989, I don't think in terms of downturn," says EniChem's Artali. "I don't think 1989—especially in the plastics sector—will be as good as 1988. It will be a more reasonable year." What Artali sees as crucial, however, is a reactivation

of companies' rationalization programs. "The danger of 1988 is that too many people have been convinced that most of the rationalization has been done. That is not correct. We have to rationalize not just by cutting capacity but by reorganizing the chemical industry itself. Making money has been easy, and we've needed a year like that. But 1988 can't be thought of as a standard year—that would be foolish."

Other companies agree with the need to rationalize further. For example, an economist at BP Chemicals points out a need "for rationalization or joint ventures in Western Europe, especially in polyethylene. There are 15 to 18 players, and that's still too many."

Montedison officials also think that a slowdown in 1989 could be avoided by increased concentration in the chemical industry. The industry could increase its profitability, they add, by closing plants in particular that are poorly located. Montedison and EniChem both believe that their joint venture, EniMont, which early next year will combine most of the chemical units of the two companies, is a good example of such rationalization.

More rationalization indeed should be done, add Neste officials, who think the 1990s will see a smaller number of larger producers in the marketplace. Officers at Atochem, the chemical arm of Elf Aquitaine in France, likewise agree that there are too many producers of commodity chemicals in Europe, compared with the U.S. or Japan, but they make the painful point that "it is difficult to bring about restructuring when everyone is earning a lot of money."

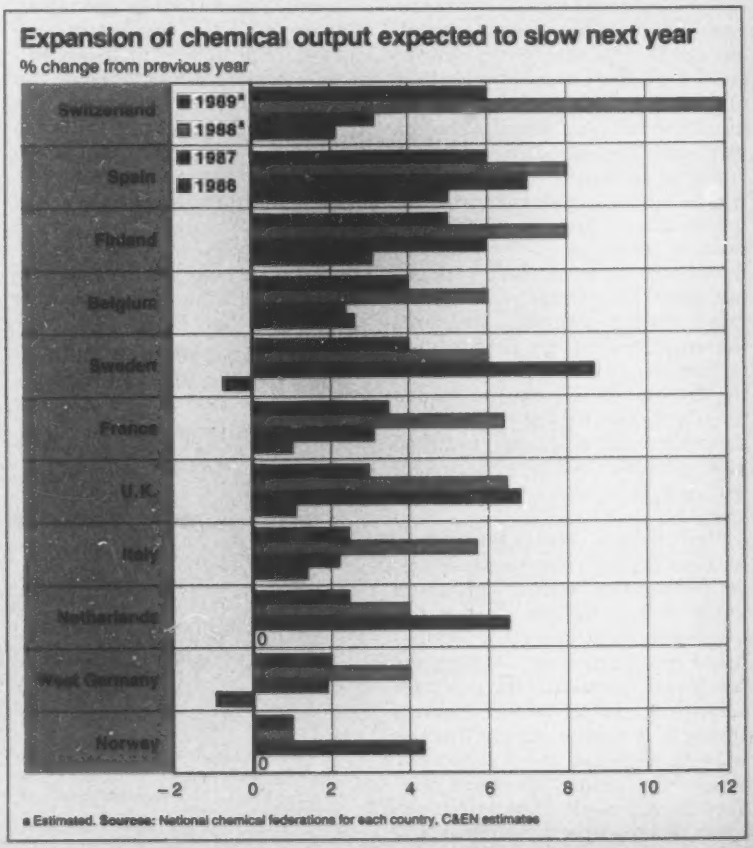
On the other hand, Antonio Sernia, vice president of EniChem, told the European Petrochemicals Association in Monte Carlo last September that there still is room for carefully considered building in the chemical industry. "We now have low raw material costs, high capacity utilization, and plants that have been mostly amortized," he said. "If we are realistic, we have to admit that low costs cannot be relied on indefinitely. Moreover, all production plants have their life cycle." Today's profit margins, he added, support a selective "scrap-and-build" policy. This is especially true where new plants can incorporate technological improvements to increase energy savings (one factor, he contends, responsible for pushing down the cost of crude oil) or where spending to reduce environmental problems will "ensure that we are not faced with a rapid escalation of regulatory pressures."

BASF's Albers notes that "for some products, growth now is limited by capacity bottlenecks. We are offsetting this by expansions. Strong stimuli are still apparent in our chemical operations."

Part of the stimuli comes from what Shell's Pinnington terms a technological revolution in applications for plastics, fibers, and other materials. "People are doing a lot of downstream work on polymers: substituting, creating new applications," he points out. Growth during 1989 will slow down, he agrees, but nonetheless new applications are increasing and finding new end-use markets.

Among the more buoyant sectors in Western Europe is the motor vehicle industry, a major market for the chemical industry. Western European car production is on target for a best-ever total of 12.5 million units, up from last year's record 12.2 million, with production being stretched to meet demand. European autos still dominate the European market, moreover. Japanese cars, for example, account for only about 12% of registrations throughout Western Europe. That means most of the European auto industry's demand for chemicals is fed by Western European producers.

There are some clouds on the industry's horizon, however. The European Community's single internal market of 1992 eventually will have some impact on the chemical industry. There already is some dispute among EC members, for example, as to what percentage of EC-



sourced parts qualifies a vehicle as "European"; the British, for example, claim it should be 60%, but the French are holding out for 80%. The relatively high proportion, in either case, has helped hold down imports. But it runs counter to the increasingly global nature of the entire motor vehicle industry, with its increasing emphasis on global sourcing—and concomitant global supplying of chemical products.

The 1992 integration clearly will involve some automotive standardization. The single market, for one thing, would remove such barriers as exhaust emissions standards that are fixed at a variety of levels. EC's own studies show cost savings in design and engineering, as well as tooling, marketing, and distribution.

Now in the messy process of being thrashed out are more uniform antipollution standards. Back in 1985, the Commission of the European Community agreed on several such standards: restrictions on carbon monoxide and hydrocarbons that probably would be tough enough to require catalytic converters for all new cars over 2 L in engine size. Cars with smaller engines also faced tightened, although progressively less stringent, standards, some of which also could be met by lean-burn engines. The initial deadlines agreed to by the commission broke down this year, so there is no current coherent target. But most auto industry observers think that antipollution standards inevitably will be tightened.

That, in turn, will mean increasing demand for the plastics needed to make lighter-weight vehicles, catalysts for pollution control, and even new gasoline additives to replace lead alkyls as octane boosters in gasoline.

Significant weakness this year in markets for both fibers and fertilizers in Western Europe figure high in forecasts for the coming year.

Consultants at Tecnon, a London-based consulting firm, for example, see the fibers market as weak for acrylics, mixed for polyamides, but strong for polyester. Acrylic demand remains depressed as fashions move away from knitted garments, says Tecnon, although demand for nylon is picking up somewhat, at least in such markets as hosiery, household textiles, and carpets.

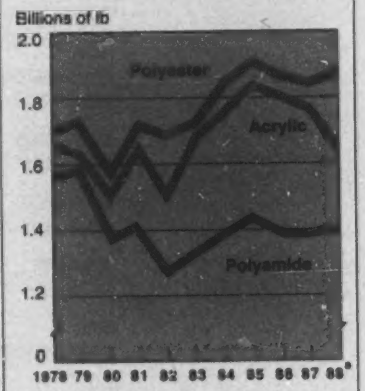
The fertilizer industry, meanwhile, continues to suffer from what many observers see as structural problems—still too much capacity for a market that will be slowly but inexorably shrinking in years to come. The situation has demanded major rationalization, such as that undertaken by Norsk Hydro with its Cofaz operations in France, which it purchased in 1987. In 1988, the company earmarked more than $150 million to modernize Cofaz facilities, as well as to restructure and streamline Hydro's own fertilizer production.

Output from the new facilities will replace that from older units in Cofaz, as well as imports to France from plants in the Netherlands, explains Finn Hvistendahl, managing director of Cofaz. Among his goals is to trim Cofaz's fixed costs and to reduce its labor force nearly 20%.

His colleague in Oslo, Trygve Refvem, head of Hydro's agricultural division, adds that in the European market for fertilizer, "prices are still so low that it is not possible for producers to operate at a profit. For Hydro, however, it is a clear target to operate so rationally that a reasonably good profit can be achieved, even with the present very low prices."

For European chemical producers, there are both positive and negative aspects to rapidly fluctuating currencies, particularly in the slide of the U.S. dollar during the past year or two.

Fiber output remains below 1985 level in West Europe



a Estimated. Source: CIRFS (International Rayon & Synthetic Fibers Committee)

Although the chemical industry may not be so dramatically hit as some other industries, such as the auto industry, certainly profits from chemical operations owned by Western European companies in North America are being hurt when earnings in dollars are brought home and translated into stronger European currencies. However, a weaker dollar provides a significant benefit by restraining feedstock costs. Not only is oil currently much cheaper on an absolute price basis of about $15 or less per barrel than it was in the early 1980s, but that $15 is weaker, too.

Moreover, high capacity utilization—what Western European producers are calling "occupacity"—is resulting in higher chemical prices. And that, in turn, limits the effects caused by a weak dollar. Exceptions to this situation tend to be in markets where pricing is commonly in dollars, in textile fibers, for example, where weak pricing is compounded by overcapacity in Western Europe.

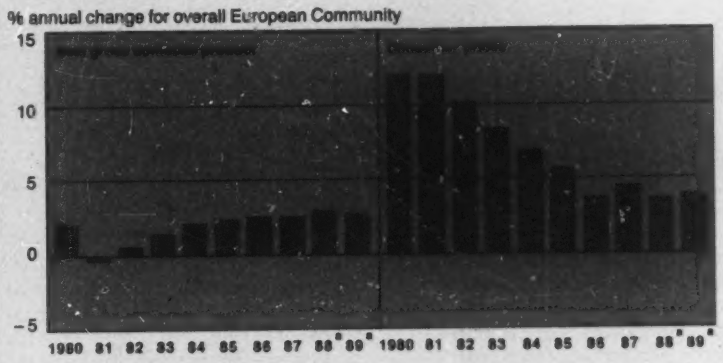
Wolfgang Hilger, chairman of the board of West Germany's Hoechst, notes that in fibers, "it had not up to now been possible to absorb the rise in raw-material prices by increases in selling prices."

Chemicals are a significant export category for countries in Western Europe—indeed, they rank among the top five exports in most countries there. Much of the output, however, is still bound primarily for domestic destinations or to other European countries. Sales within these countries—particularly to and from countries with similarly stable currencies—suffer less from adverse currency translations than exports to weak-currency markets.

In the long run, however, currency fluctuations have relatively little impact on strategic planning for most chemical producers. Says a BP official, "We are looking at what we consider stable, long-term relationships between currencies. That's what you base investment on. The benefits of a new plant, for example, might be 10 to 15 years out. You have to think long-term."

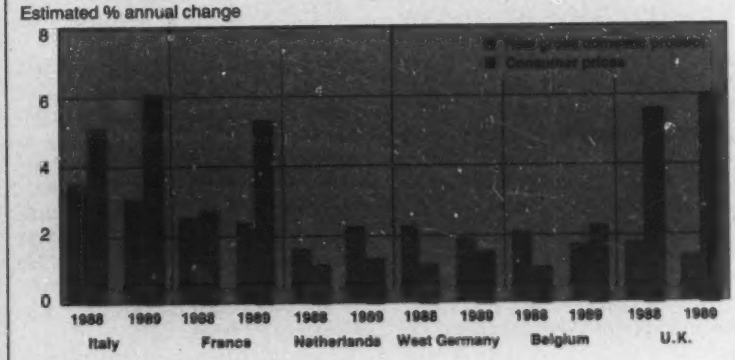
Growth continues, with inflation restrained . . .

% annual change for overall European Community



. . . but output expansion will slow in most major countries

Estimated % annual change



a Estimated. **Source:** Commission of the European Community

Other companies—Akzo of the Netherlands and Degussa of West Germany, for example—agree that currency plays little part in their strategy. Says an Akzo spokesman: "Acquisitions and major investments are made for strategic reasons; currency fluctuations do not play an important role in the decision making." And Degussa officials add that the dollar position "has not at all influenced Degussa's decisions regarding acquisitions or expansions in the U.S. Our company rather is planning in long terms, with a view on the world's largest market."

Investment in new chemical plants next year in Western Europe undoubtedly will continue the trend of recent years of putting more money into specialty chemicals than in commodity operations. In 1988, too, new investment frequently was in the U.S.

Industrywide, capital spending is expected to slow a bit in 1989 from the pace of this year. Van de Vaet, for instance, forecasts that it will increase 6%, down from the exceptional rise this year of 9%. But with cash flow coming on strong for chemical companies, more of them are plowing more money into plant replacement, as well as into research and development.

Jim Gordon, chemical coordinator for the Shell group, notes that throughout the European chemical industry depreciation charges generally have been greater than capital investment. That has prompted a concern that the industry has not been reinvesting enough in its future, he says. In the past two or three years, however, that situation has been changing.

Much new investment must address environmental and pollution-control measures. Akzo, for one, says that pollution-control investment, as a share of its total capital spending budget, is expected to rise considerably; this year investment associated with the environment will account for about 15% of the company's total.

Few people in the industry quarrel with higher investment in R&D or environmental protection. But what clearly has the industry worried about the coming year is the prospect of a new wave of capacity build-up for all the petrochemicals and their derivatives that now are in tight supply.

Expansion as a result of debottlenecking and capacity-creep additions already is leading to significant growth in capacity. If growth rates for demand continue next year in the 3 to 4% range, these incremental expansions will only meet market needs. But if markets should grow 8 to 10%, that little expansion will be inadequate. Then, many in the industry fear, companies will rush headlong into building entire new plants, fearing that they cannot afford to be left behind, not if they want to continue to be a major player in the market.

Incremental expansions may push capacity utilization rates down to more desirable levels of 90 to 95% from the more than 100% level that has recently been the case for some plastics. How this is regarded depends on one's level of optimism. People worried about a potential economic downturn see capacity utilization falling to 85% or even below, so that current healthy profit margins will rapidly become more sickly. Two many people jumping on the expansion bandwagon would not help matters.

But no matter what investment decisions are taken during the coming year, they probably cannot be put into effect quickly enough to have a significant impact on the performance of the industry in the immediate future. □

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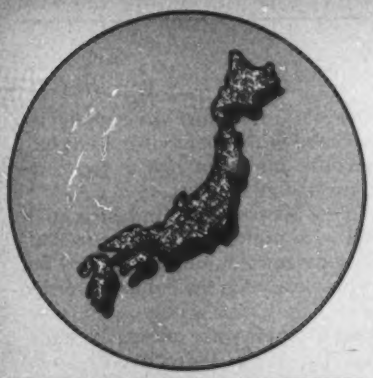


With demand strong, profits surge for chemical firms

Despite its trade deficit, the chemical industry is flourishing and petrochemical supplies are tight

Earl V. Anderson
C&EN Northeast News Bureau

Japan's chemical industry, like several other of its industries, is proving that a lopsided trade surplus isn't needed to survive. The industry not only is surviving but flourishing without it. The chemical industry hasn't enjoyed a trade surplus since 1981. It won't have a trade surplus in 1988, either.

This year, in fact, Japan's chemical trade deficit probably will reach a new high—with chemical imports $800 million higher than chemical exports. Nevertheless Japan's chemical companies are turning in a strong performance this year.

The reason lies close to home—in Japan's own geographically small but highly populated domestic market. Two years ago Japanese economic gurus warned that as the yen strengthened against the U.S. dollar, making it more difficult for all Japanese industry to compete in the international marketplace, the country's economic expansion would be derailed.

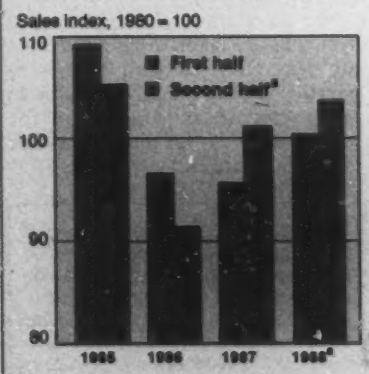
It would, that is, unless Japanese industries, including the chemical industry, reoriented themselves to thrive in a domestic-driven, rather than an export-driven, economy. Reorient they did. Spurred by strong consumer demand and high capital investment, Japan's domestic economy has been growing briskly since late last year.

Despite a downturn in the second quarter, in fact, the economy has been soaring. In the first quarter, gross national product grew at an annual rate of 11%. And indications are that economic growth picked up steam again in the third quarter, although expansion was not so strong as earlier in the year. This growth probably carried over into the fourth quarter as well.

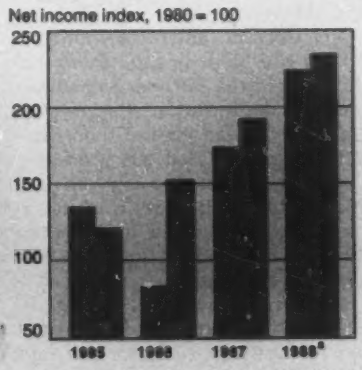
Strong domestic demand, coupled with stringent cost-cutting programs, has been an elixir for Japanese company profits. According to a survey of 392 Japanese industrial companies conducted by the economic publisher Nihon Keizai Shimbun, corporate profits in the first half of fiscal 1988 (ended Sept. 30) were a heady 65% higher than in the first half of fiscal 1987, the highest gain in 15 years.

Chemical companies are participating in this profit surge. Although growth in their profits may not measure up to that for industry as a whole, a survey of a dozen major chemical producers indicates that the industry's profits were up a

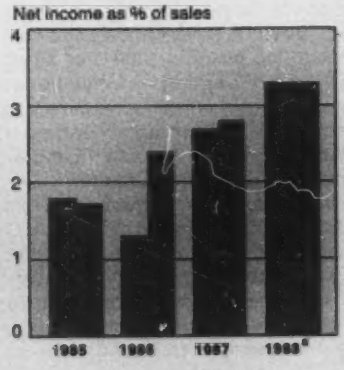
Sales improve modestly for Japanese chemical firms . . .



. . . but earnings are sharply higher . . .



. . . as profit margins show healthy expansion



Note: Based on the results of 12 leading Japanese chemical companies: Asahi Chemical Industry, Dainippon Ink & Chemicals, Hitachi Chemical, Mitsubishi Kasei, Mitsubishi Petrochemicals, Mitsui Toatsu Chemicals, Sekisui Chemical, Showa Denko, Sumitomo Chemical, Takeda Chemical Industries, Teijin, and Toray Industries. The fiscal year for most, but not all, of these Japanese companies ends March 31 of the following year. a Estimated for second half. Source: Toyo Keizai Shinposha

healthy 30% in the first half of fiscal 1988 and likely will increase 21% during the second half, which ends next March 31.

At least part of the difference between the chemical industry's 30% profit gain and the all-industry gain of 65% in the first half could lie in the fact that the Nihon Keizai Shimbun survey is based on profits before taxes and extraordinary items. The chemical industry results, based on estimates made by Toyo Keizai Shinposha, a Japanese financial publisher, reflect net profits after taxes.

However measured, chemical company profits will be more than satisfactory this year. Dainippon Ink & Chemicals, for instance, estimates that its pretax profits for this fiscal year will be up 18%. Unitika, the textile giant with substantial plastics operations, looks for a 14% gain. And Mitsubishi Kasei, Japan's largest integrated chemical company (which is changing its fiscal year), estimates that its pretax profits will increase 20% on an annual basis.

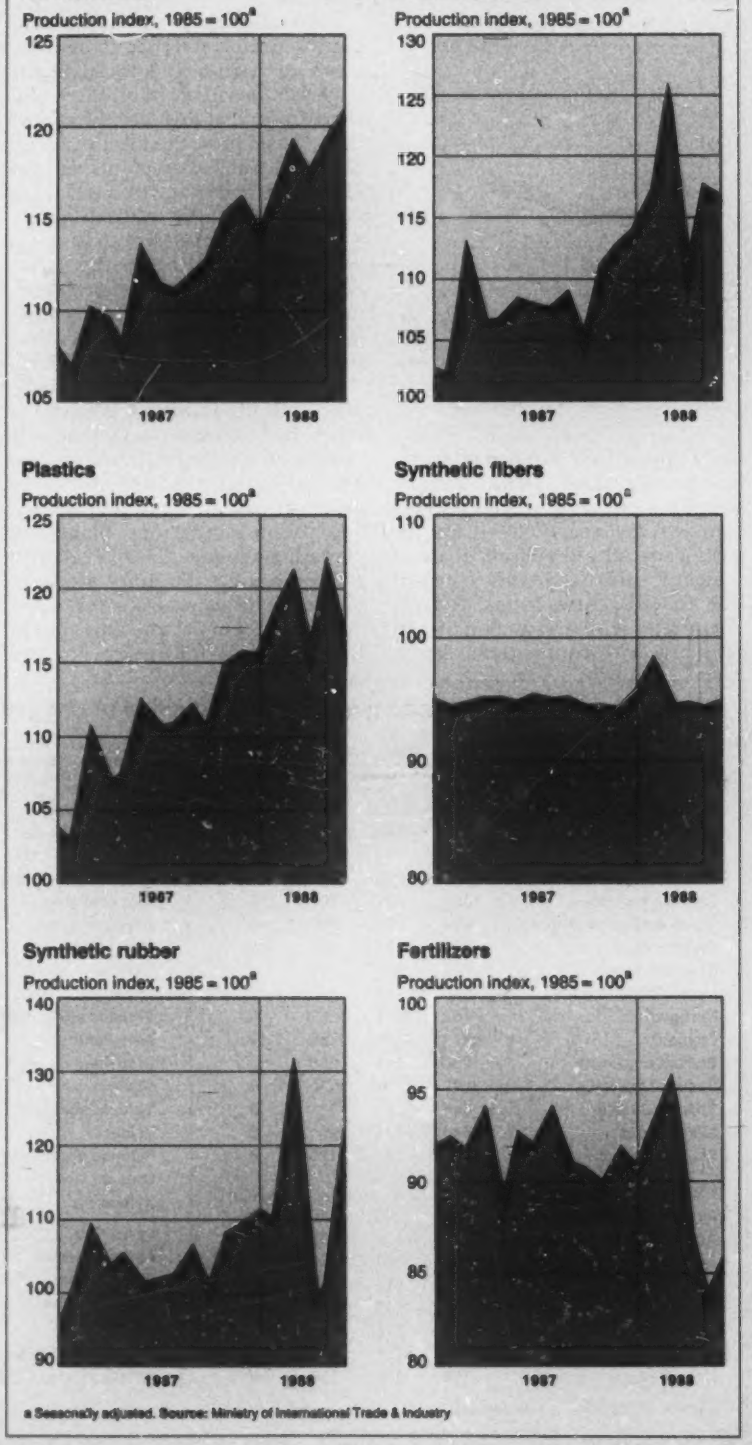
However, Showa Denko, another large, integrated chemical company, expects its pretax profits to almost double in fiscal 1988. The company is a microcosm of the Japanese chemical industry. In basic and intermediate petrochemicals, Showa Denko is benefiting from a combination of strong domestic demand and low naphtha prices, the primary petrochemical feedstock in Japan.

Meanwhile, its ceramics and engineering plastics operations typify the increasing tendency of Japanese chemical companies to move into products having a higher value-added. For Showa Denko, ceramics and engineering plastics are rapidly growing and very profitable businesses.

The Japan Fine Ceramics Association estimates that the market for fine ceramics will total between $30 million and $55 million by the end of the century, at current yen-dollar exchange rates. But ceramics are only one avenue that Japanese chemical companies are pursuing in their diversification drive into high-tech and high-value-added products.

Takeda Chemical Industries, Japan's top pharmaceutical company, is building two new laboratories to

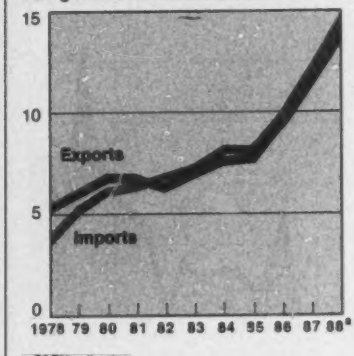
Chemical output rises strongly but fibers and fertilizers lag



a Seasonally adjusted. Source: Ministry of International Trade & Industry

Chemical exports, imports both soar in dollar terms

Foreign trade in chemicals, $ billions



a C&EN estimates
Source: Ministry of International Trade & Industry

study agricultural science and other nondrug areas. Denki Kagaku Kogyo's new long-range business plan—to the year 2000—calls for raising specialty chemicals' share of company sales from their present 28% to 60%. And Mitsui Toatsu Chemicals, which says that it can get along with conventional large-volume products "for the time being," is building a new life sciences lab.

Although Japanese chemical companies doubtlessly consider the move to high-tech and advanced materials very important, there also is no doubt that many of them now in the basic petrochemical industry can, as Mitsui Toatsu points out, get along with conventional large-volume products for the time being.

Japan's petrochemical industry is booming. According to the Japan Petrochemical Industry Association, no fewer than 12 major petrochemicals set new production records during the first nine months of 1988.

Ethylene production, the bellwether of the industry, is likely to top 5 million metric tons this year to set a new record. Output has not been so high since 1979. With ethylene capacity in Japan estimated at 5.2 million metric tons, plants are operating about as close to capacity as they can get. Supplies are tight for ethylene as well as for other major petrochemicals. Mitsubishi Petrochemical Industries, for the first time, actually is importing ethylene.

The Japanese Ministry of International Trade & Industry expects the petrochemical boom to continue, at least through the fourth quarter of calendar 1988. It estimates that demand for ethylene and its polyolefin derivatives will range from 2 to 5% higher than during the fourth quarter of 1987. MITI estimates that ethylene demand during this quarter will be 1.3 million metric tons, about the same as the nameplate capacity of the country's ethylene plants.

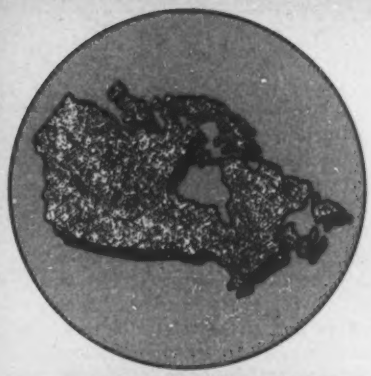
The Japan Petrochemical Industry Association believes that brisk petrochemical business can be expected even beyond the end of this year. "I have no serious concern about developments in the petrochemical business," says one association official.

This optimism could be justified. Economists in Japan see no slowdown in Japan's strong domestic consumption and investment, the two pillars on which the country's recent economic expansion has been based. □

Strong growth is widespread this year in production of chemicals

Thousands of metric tons unless otherwise indicated	1987	Six months 1988	Six months 1987	% change
INORGANIC CHEMICALS				
Ammonia	1784	889	871	2%
Ammonium chloride	332	153	185	−17
Ammonium sulfate	1804	906	897	1
Calcium carbide	354	202	200	1
Calcium superphosphate	499	254	269	−6
Carbon black	629	354	309	15
Chlorine, liquid	911	494	452	9
Hydrochloric acid	543	282	269	5
Nitrogen[a]	6452	3416	3162	8
Oxygen[a]	6878	3799	3189	19
Sodium carbonate	1098	542	558	−3
Sodium hydroxide	3227	1721	1575	9
Sodium silicate	664	341	313	9
Sulfuric acid	6541	3388	3259	2
Titanium dioxide	238	130	120	8
ORGANIC CHEMICALS				
Acetaldehyde	285	168	140	20
Acetic acid	367	192	165	16
Acetone	260	144	132	9
Acrylonitrile	573	288	271	6
Benzene[b]	2224	1159	1146	1
Butadiene	707	376	339	11
Butanol	259	127	120	6
Caprolactam	470	246	233	6
Cyclohexane	557	290	276	5%
Dioctyl phthalate	261	127	127	0
Ethylene	4585	2452	2262	8
Ethylene dichloride	2051	1093	1021	7
Ethylene glycol	313	183	167	10
Ethylene oxide	484	254	251	1
Methanol	181	113	85	33
Octanol	257	121	110	10
Phenol	308	180	162	11
Phthalic anhydride[b]	172	83	82	1
Propylene	3370	1798	1661	8
Propylene glycol	236	130	114	14
Styrene	1559	823	758	9
Terephthalic acid	1047	573	491	17
Toluene	881	511	428	19
Toluene diisocyanate	91	42	40	5
Urea	729	398	369	8
Xylene	1767	967	856	13
PLASTICS				
Phenolic resins	332	176	159	11
Polyethylene	2182	1124	1059	6
Polypropylene	1406	765	712	7
Polystyrene	1735	909	827	10
Polyvinyl chloride	1663	876	875	0
SYNTHETIC RUBBER	1192	655	586	12

a Millions of cubic meters. b Petroleum-based product only. Source: Ministry of International Trade & Industry



Rising exports buoy already surging chemical sales

With demand strong and supplies tight, Canadian producers are expanding their ethylene capacity

Earl V. Anderson
C&EN Northeast News Bureau

For the Canadian chemical industry, 1988 has been a very good year.

Although expansion in the Canadian economy is likely to slow down—1989 growth in gross domestic product is expected to be only about 2%, compared with 4% this year—the chemical industry probably will be able to squeeze at least one more good year out of what has so far been a six-year recovery from the 1981–82 recession.

For most Canadian chemical companies, and for most of their products, demand has been strong in both domestic and export markets throughout all of 1988. And although production is up virtually across the board, supplies are tight in many product areas, particularly in basic and intermediate petrochemicals. This situation has triggered higher prices for chemical products which, in turn, has meant much fatter—in fact, often record—profits for many Canadian chemical companies.

A good example is Celanese Canada. Through the first nine months of 1988, its sales were up 18% (on a Canadian dollar basis) to $237 million (in U.S. dollars; $1.00 = 1.24 Canadian dollars on Sept. 30). But net income was a hefty 87% higher than in the first nine months of 1987.

Much of the credit for the increased profitability company president Paul H. Williams attributes to the firm's chemicals and industrial products group. Celanese's methanol unit, for instance, has been operating at capacity, with prices increasing as recently as the third quarter. In Canada, methanol output in the first nine months was 1.5 million metric tons, 36% higher than last year's pace.

At Union Carbide Canada, sales ($339 million) were running 38% ahead of last year through the first nine months. But profits were up 79%, excluding an extraordinary gain from the sale of common shares in Polysar Energy & Chemical. A major factor in Carbide Canada's profit picture is the performance of Pétromont, the Montreal ethylene producer that Carbide owns jointly with Le Groupe SGF.

Pétromont, along with other Canadian ethylene producers, has been hard-pressed to meet demand. Production of ethylene in Canada is booming, buoyed by strong demand in such derivatives as polyethylene, polyvinyl chloride, and polystyrene.

Through the first nine months, total Canadian ethylene output was 1.73 million metric tons, 11% more than in the first three quarters of 1987. By year's end, it likely will reach at least 2.3 million metric tons, or perhaps even slightly more.

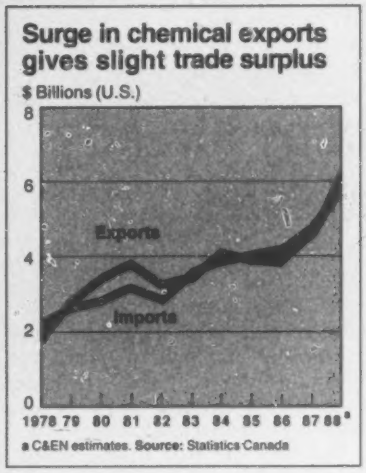
Both low-density polyethylene (LDPE) and high-density polyethylene (HDPE) are strong performers this year. Output probably will be, respectively, 1.1 million and 315,000 metric tons for the whole year, a 10% gain for LDPE and a 17% advance for HDPE.

Through the end of September, output of polystyrene, including acrylonitrile-butadiene-styrene resins, was up 11% to 163,000 metric tons. And, although production figures aren't reported for polyvinyl

Production of fertilizer materials makes a strong comeback

Thousands of metric tons	Production					% change
	1988[a]	1987	1986	1985	1984	1987–88
Ammonia	4000	3512	3540	3620	3493	14%
Ammonium nitrate	1100	844	948	1054	969	30
Ammonium phosphate	945	941	1149	1301	1383	0
Benzene	690	720	635	588	557	−4
Chlorine	1650	1635	1536	1424	1424	1
Ethylene	2300	2140	1909	1744	1464	8
Hydrochloric acid, 100%	175	164	153	158	161	7
Phosphoric acid, 100%	450	464	547	627	691	−3
Polyethylene, high density	315	269	242	229	227	17
Polyethylene, low density	1125	1021	887	733	529	10
Propylene	630	628	628	648	665	0
Sodium chlorate	495	432	373	336	313	15
Sodium hydroxide	1720	1770	1696	1589	1575	−3
Sulfuric acid	3700	3437	3536	3890	4053	8
Urea	2700	2142	2330	2033	2110	26

a C&EN estimates. Source: Statistics Canada



chloride, it's a safe bet that it, too, is running well ahead of last year.

With ethylene units operating at, or near, capacity, Canadian chemical companies are planning some major expansions for that basic petrochemical. Alberta Gas Ethylene (AGE) is building its third ethylene unit at Joffre, Alberta. A mammoth 680,000-metric-ton unit due on stream in 1992, it will raise AGE's total ethylene capacity at Joffre to just over 2 million metric tons per year.

Meanwhile, Dow Chemical Canada also will build a new ethylene plant in Alberta. The world-scale 450,000-metric-ton unit will be built at Fort Saskatchewan and may be on stream as early as 1993. And Polysar has received directors' approval to expand its ethylene capacity at Corunna, Ontario (near Sarnia). The expansion, which is expected to be completed by the first quarter of 1990, will increase capacity at Corunna 20% to 544,000 metric tons per year.

Even fertilizer, which has suffered through weak markets in recent years, is participating in this year's chemical bonanza. Ammonia output in Canada probably will be up 14% this year to 4 million metric tons. Urea production will rise a hefty 26% to 2.7 million metric tons. This turnaround is helping fertilizer companies' bottom line.

For fertilizer, as for many other chemicals produced in Canada, increased sales and profits are coming in good part from exports. Overall, Canadian chemical exports this year are expected to hit $6.2 billion, 26% higher than last year. About 62% are going to the U.S.

Imports, meanwhile, will increase 17% to $5.9 billion, with 75% of them coming from the U.S. The stronger export showing will give Canada a slight chemical trade surplus this year, compared with a slight deficit last year.

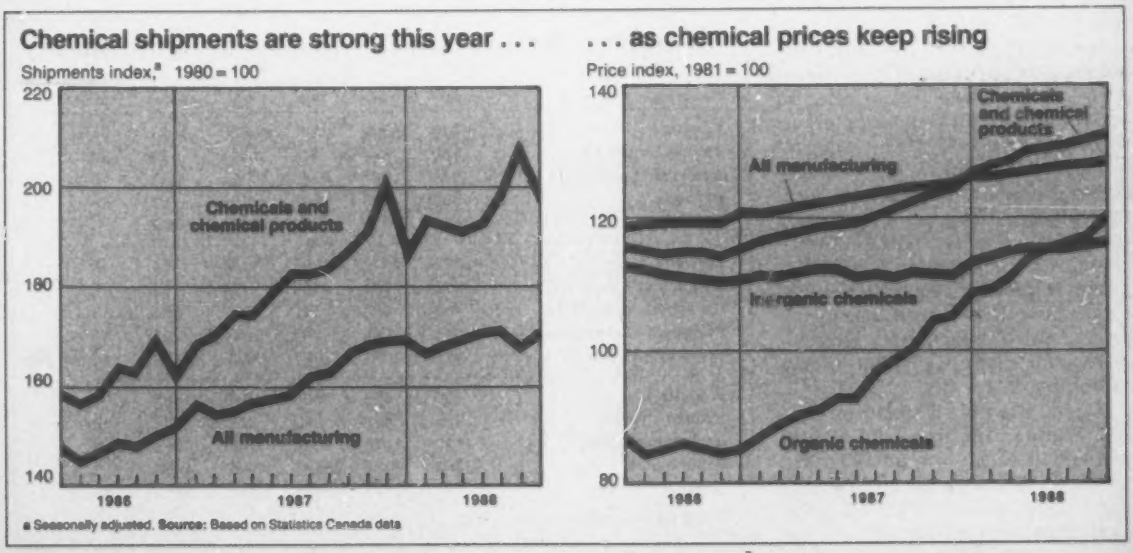
For next year, Du Pont Canada president J. Edward Newall probably sums it up best when he says, "We expect some softness in demand to develop if the widely forecast slowdown in economic growth materializes."

Certainly most economists think economic growth will slow, both in Canada and in the U.S., which is by far Canada's most important chemical export market. Although this undoubtedly will put a crimp in demand for Canadian chemicals, it could be a blessing in disguise if it relieves the threat of inflation, assuming an outright recession can be avoided.

There are other economic factors that the Canadian chemical industry must also consider in 1989. One is the new free trade agreement with the U.S. If Canada approves the pact, as now seems assured, Canadian chemical companies will enjoy heftier profit margins, if not heftier sales, from exports to the U.S.

And then there are the fluctuations in the Canadian dollar. It has been strong against the U.S. dollar all year, hitting 84 cents (U.S.) late last month. It was as low as 72 cents in 1985.

Some Canadian exporters may have trouble competing in export markets and against imports into Canada at the current high levels for the Canadian dollar. However, many economists are predicting that the Canadian dollar will retreat to about the 78-cent level next year, which should make it easier for Canadian chemical firms to compete with their international rivals. □



Perestroika is revamping East bloc's chemical industry

Chemical industry gets high priority in current industrial expansion plans of U.S.S.R., East Europe

Richard J. Seltzer, C&EN Washington

Economic, industrial, and political developments in the Soviet Union and Eastern Europe have come to be dominated by one word—perestroika, the far-reaching restructuring of economic and social mechanisms and institutions launched by Soviet leader Mikhail S. Gorbachev.

In the U.S.S.R., a package of reforms took effect at the beginning of 1988 for a significant fraction of chemical and other industrial enterprises, and additional enterprises will be transferred to "complete economic accountability and self-financing" on Jan. 1. The aim is to replace centralized, directive management of the enterprises with more decentralized and entrepreneurial decision making, to expand the role of such market incentives as prices, wages, and profits, and to cut back bureaucracies.

Restructuring processes are also under way in Hungary, Poland, Bulgaria, and Czechoslovakia. Only East Germany and Romania—under old-guard leaders Erich Honecker and Nicolae Ceauşescu, respectively—are resisting alteration of their centrally planned economic systems.

The reforms are going slowly and meeting with considerable opposition. Implementation so far has failed to bring many benefits, and has generated much confusion and controversy—perhaps even impeding economic and industrial growth in the short run—notes a recent report from the WEFA Group (formerly Wharton Econometric Forecasting Associates).

However, Soviet and most Eastern European leaders see no other way forward. "There will be no future for Poland if the industrial structure that has developed over the course of decades is not thoroughly changed," says the nation's new Prime Minister, Mieczyslaw Rakowski. Czechoslovakia must abandon its "well-used and dead-end paths," proclaims a government statement. The time has come for "profound socioeconomic changes," stresses an official Bulgarian newspaper. Several countries, such as Hungary, plan for periods of austerity, cuts in the standard of living, and temporary layoffs of workers as an "unwelcome but necessary concomitant of the restructuring of the economy."

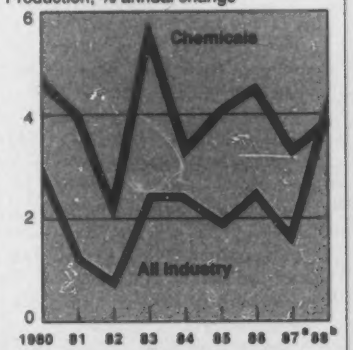
Nations of the region give high priority to their chemical industries in current five-year plans, now completing their third year. The Soviet Union, for instance, has adopted a comprehensive program for "chemicalization" of its national economy by the year 2000.

Top Soviet goals are to step up production of plastics, fibers, fertilizers, preservatives, pesticides, petrochemicals, dyes, and various chemical additives and reagents, according to Veniamin G. Afonin, chief of the Chemical Industry Department in the Communist Party Central Committee. The aim is to develop substitutes for expensive natural materials, simplify technology, and improve the quality and yields of agricultural products. And the Soviets are highly dependent on imported technology to make advanced chemical products, such as synthetic fibers and plastics, notes a recent U.S. Congressional report.

The five-year plans of nations in the region generally call for more rapid growth in the period 1986 through 1990 than was achieved or targeted in the previous five years. Thus, industrial output of the six Eastern European countries is supposed to rise 4.4% a year, compared with 2.8% annual growth from 1981 though 1985. Soviet industry is slated to raise output 4.6% a year, compared with 3.7% a year in the 1981–85 plan.

However, results this year and the past two years indicate that the 1990 targets will not be met. Last year, industrial growth slowed in the U.S.S.R. to 3.8% and in the oth-

Industrial output up this year in Soviet Union



Note: All figures except for 1988 are based on Central Intelligence Agency estimates, which are lower than official Soviet statistics because of postulated upward bias in Soviet figures. a Preliminary. b For first nine months; official Soviet figure for 1988 is for "chemical and timber complex," rather than just chemical industry. Sources: Central Intelligence Agency, U.S.S.R. State Committee for Statistics

er six nations to 3.4%. Industrial output is growing faster this year, but not enough to make up the difference. Czechoslovakia, for example, has scaled back its industrial growth goal for 1989 to just 2.2%, well below the 3.5% a year envisaged in the five-year plan.

Soviet industrial output through September rose 4.3% compared with the same period last year (the 1988 goal is 4.5%). Hungary's output was up just 0.3% through August (the target is 1%).

However, Bulgaria's industrial output for the first nine months was up 5.4% (the 1988 goal is 5.0%). Czechoslovakia's output was up 2.6% through September (the goal is 2.3%). And East Germany's was up 7.9% in the first half of 1988. Poland's industry faltered in 1987, growing just 3.3%, but it rebounded with 6.3% growth through June this year.

Befitting its high-priority status, the Soviet chemical industry is growing faster this year than is industry overall. The Soviet "chemical and timber complex," for instance, raised output 3.9% in the first seven months of this year. The chemical component of this complex, the Ministry of the Chemical Industry, grew much faster than most other components, increasing production 6.7%. Another component, the Ministry of the Medical & Microbiological Industry, was up 6.9%. Growth was slower at the Ministry of the Timber Industry (4.4%), Ministry of the Production of Mineral Fertilizers (2.7%), and Ministry of Petroleum Refining & Petrochemical Industry (2.1%).

Soviet production of mineral fertilizers was up 3% through August compared with last year. Sulfuric acid and sodium hydroxide were each up 2%, synthetic fibers up 3%, and pharmaceuticals up 5%.

However, Soviet output of pesticides, measured through August, dropped 3% from the same period last year. And the U.S.S.R. State Committee for Statistics notes that the Ministry of the Chemical Industry is not fulfilling state orders for production of highly efficient types of plastics (polystyrene, polyvinyl chloride, polyethylene, and polypropylene), for thermoplastic pipes, and for detergents. Furthermore, a serious backlog has developed in some plants making basic raw materials. For example, almost half of 27 synthetic ammonia-producing units have not met targets through September, and sulfuric acid production was 478,000 metric tons below target.

Meanwhile, East Germany raised chemical production a remarkable 12% through June this year, compared with only 3.7% growth for all 1987. This was the highest of any industrial branch in the country except for electrical engineering and electronics. Output of high-density polyethylene was claimed to be up 82%, polyvinyl chloride 26%, and nitrogenous fertilizer 10%.

Czechoslovakia's chemical industry increased output 3.4% through September, surpassing its target. Two components of this industry also exceeded their goals—petrochemicals and crude oil refining (up 3.5%) and rubber and plastics (up 2.5%).

In addition, Bulgaria's biotechnological and chemical industry raised output 6.6% through June, recovering from just 1.3% growth in all 1987 and surpassing the 6.4% goal set for 1988. This growth was led by strong performances by plastics and high-value-added petrochemicals. Fine and specialty chemical production is slated to grow about 15% this year, as well.

Hungary's chemical industry grew 2.1% overall in the first eight months of 1988—but omitting the energy sector, output of chemicals climbed 5.8%. And Poland's chemical industry expanded at a 7.2% clip in the first half of 1988.

The Romanians release almost no economic and industrial statistics, and what they do release is extremely suspect. The nation's plan targets for 1988 are "pure fantasy, more unrealistic than ever," says one source. It set goals of a 9 to 10% rise in national income and 7 to 8% in industrial output, predicated on high growth in labor productivity by an "already demoralized work force."

The Romanian five-year plan calls for raising chemical and petrochemical output 50% and exports 70% between 1986 and 1990. Priorities are fine synthesis and small-tonnage chemistry, ultrapure substances, semiconductors and monocrystals, highly pure reagents, organic pigments, lacquers, and dyes. Romania's chemical industry already contributes 20% of the country's industrial output and 25% of its exports. □

Soviet chemical output up, but much of East Europe's lags

Thousands of metric tons, 1987	U.S.S.R.	Bulgaria	Czechoslovakia	East Germany	Hungary	Poland
Mineral fertilizers[a]	36,300	932	na	5100	na	na
Change from 1986	4.5%	−1.9%	na	1.1%	na	na
Nitrogen (N)	15,906	801	596	1300	600	1543
Change from 1986	4.5%	−2.1%	−2.9%	3.8%	2.7%	6.8%
Phosphate (P_2O_5)	9,697[b]	131	277[b]	300[b]	177	942
Change from 1986	4.5%	−0.8%	−9.8%	−3.0%	8.6%	−0.6%
Potassium (K_2O)	10,688[c]	—	na	3500	na	na
Change from 1986	4.5%	—	na	0.4%	na	na
Sulfuric acid, 100%	28,531	689	1264	866	573	3147
Change from 1986	2.5%	−14.6%	−2.2%	−2.0%	5.5%	6.1%
Ammonia[d]	20,470	1070	na	na	na	na
Change from 1986	4.5%	−2.0%	na	na	na	na
Plastics	5,500[e]	319	1152	na	539	639
Change from 1986	2.9%	−24.0%	1.1%	na	26.5%	1.1%
Sodium hydroxide, 100%	3,285	104	338	na	197[f]	425
Change from 1986	1.8%	−24.6%	0.9%	na	−2.5%	−0.5%
Synthetic rubber	2,360	25	75	85	na	117
Change from 1986	1.7%	0%	−1.3%	−28.0%	na	0.9%

Note: Romania is not included because of the unavailability of data on its chemical production in 1987. a Nutrient content basis. b Includes ground phosphate rock for direct application and phosphate animal feeds. c Imported potash added to domestically produced nitrogen and phosphate to form multinutrient fertilizer. d Nitrogen content basis. e Includes resins for man-made fibers. f Includes regenerated NaOH. na = not available. **Sources:** Central Intelligence Agency, state central statistical bureaus